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THE ABDOMINAL BRAIN.

LEILA G. BEDELL, M.D.

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ABDOMINAL BRAIN.

BY

LEILA G. BEDELL, M.D.

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1885.

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INTRODUCTORY.

THE paper which forms the contents of this little book and which is given now to the general public for the first time, was originally prepared for and read before the "Women's Physiological Institute of Chicago," February 4, 1884. After years of study into subjects of a strongly allied character, touching upon the *dual* physical and psychical nature of man, its preparation seemed easy, and its conclusions self-evident. Its statements, however, were not so familiar to those who first heard the paper, but it enlisted attention and there came numerous requests to "hear that paper again." Accordingly it was subsequently read at several parlor meetings; before the "State Heredity Association" at Lake Bluff; the "Froebel Association" of this City; and before the "*Athena*"—an association of women philosophers, critical and learned.

So much intelligent interest has been manifested in it, that it has seemed worth while to send it forth in tangible shape to be read, investigated, criticised, not for the glorification of the writer, but with the hope that, if there be new truths contained herein, they may carry with them that benediction which follows all truth. The subject is many-sided and its conclusions are immeasurably far-reaching.

During the Annual Meeting of the "A. A. W." (whose public sessions are known as the "Women's Congress") at Baltimore, last October, Antoinette Brown Blackwell read a paper upon the "Relative Longevity of the Sexes," in which she reached the conclusion, from ably compiled and reliable data, that women live longer than men. In speaking in the discussion which followed the paper, I attempted to make some sort of physiological explanation of the fact, and expressed my belief that it was due to the *superiority of the* ORGANIC *nature in woman;* coupling this, as its antithesis, with the statement of my belief in the *superiority of the masculine brain;* whereupon I became at once the target of such a volley of criticisms that I was obliged, in self defense, at a later meeting to "rise and explain;" and, in doing so, I said "I did not say that I was a believer in the superiority of the masculine *mind*, but of the masculine *brain*." This gave rise to a question rarely asked and still more rarely answered—"*What is mind?*" The answer which came to me then, and which I now see no reason to revise, was—"Mind is the *sum* of *all* psychical action, not of the brain alone but in both the nervous systems in man."

Returning from Baltimore I found upon my table the current number of the *Popular Science Monthly*, (November, 1884), the first article in which was by Dr. Wm. A. Hammond on "*The Relations between Mind and the Nervous System.*" A sentence in this article humiliated me when I remembered that I had attempted to define *mind*. Dr. Hammond says: "Now, what is mind? Those of you who have thought much upon this subject will not be surprised when I say that *I do not know!*"

But I shall quote from Dr. Hammond's paper some paragraphs which will interest every reader of "*The Abdominal Brain.*" He says:—

In the very earliest times of which we have any record, and even at the present day among barbarous nations, the idea existed that the brain was not the only organ concerned in the production of mind. Thus, the emotions were, many of them, supposed to have their seat in the heart, the liver, the spleen, the bowels. Love, for instance, was conceived by the heart, as were also several other tender or compassionate feelings. The liver was supposed to be intimately connected with the depressing emotions, the spleen with spite or revenge, and the bowels with pity. So strongly was this idea implanted, and so universally did it prevail, that it has influenced the forms of speech among all nations that are not so low in the scale as not to have emotions. Thus we say that a person has "a good heart," the lover tells his lady-love that he "loves her with all his heart," and the sinner when he turns away from his wickedness is said to have undergone a "change of heart." The influence ascribed to the liver is shown by our expressions "melancholic," "choleric," and by one that I heard used a short time since by a man who was complaining of an insult that had been put upon him, and who said that it made "his bile flow." Then we say of a disagreeable or quarrelsome person that he is "splenetic," or that he "vents his spleen," and we speak of a pitiless person by asserting that he has "no bowels of compassion."

How could the notions that gave birth to such expressions arise in the human mind? Doubtless, their origin was due to the fact that, under the influence of certain emotions, there are disturbances in the organs with which they are associated. Thus, the passion of love produces a sensation of fullness in the region of the heart, and the action of the organ is quickened. In mental depression, or as a consequence of fits of anger, the liver is so deranged that the bile ceases to be produced, and pain is felt in that part of the body in which the liver is situated; and, when the emotion of pity is strongly experienced, a sensation of weakness, or, as it is sometimes called, a sinking feeling, is felt at the pit of the stomach.

It has been customary with modern writers—and I have until quite recently been of the like opinion—to regard these disturbances as being the effects of emotions that originated in the brain, and not as indicating that the organs in which they are felt have anything to do with the evolution of love or anger or fear or compassion, or any other passion or feeling. The idea has become so widely spread among educated persons that the brain is the only organ of the body that has any direct relation as a generator with the mind, that it seems like a tremendous blow at the system of existing facts to attempt to take from it any of its power. But it is only recently that physiologists and pathologists are beginning to make a thorough investigation into that great division of the nervous system consisting of the sympathetic nerves and their ganglia. If you will look at this diagram, you will obtain some idea of the situation and connections of these nerves. As you see, they are situated on each side of the spine, and are in direct connection with the brain, and their ramifications extend to every one of the vital organs situated in the chest, the abdomen, and the pelvis. These nerves differ from the other nerves—those that convey impulses to and from the brain—in the remarkable fact that they have at various parts of their course little swellings or enlargements called ganglia, and which consist of gray matter. Now, gray nerve-tissue, wherever it exists, is a generator of nerve-force, or mind, and it is not unreasonable to suppose, therefore, that these masses of the tissue in question, that are placed around the heart, the liver, the spine, and other organs, and in vast number in their substance, have some influence in causing the production of those emotions that make themselves felt in the parts of the body with which former universal beliefs and our present forms of speech have associated them. We find, too, as an additional fact in support of this view, that in certain mental affections, characterized by great emotional disturbances, these ganglia are in various parts of the body the seats of disease.

Therefore, there is some reason for the opinion that not to the brain alone do we owe the evolution of mind, *but that the sympathetic system of nerves is also concerned in its production.*

Truth is eternal. It is like pure gold, whose own intrinsic worth is ample reward for its discovery. Many minds delving for it may come upon the same stratum simultaneously. But a discoverer is not an inventor, and can justly claim no credit from the world for finding out that which is in store for all who seek. The late Henry James, Sr., said that at one time in his life when he was devoting his best energies to philosophic writings, he suddenly discovered that he "cared more to be known as a discoverer of truth than for the truth itself."

Let us hope that it is for the sake of "the truth itself" that this nugget of ore is given to the public to be assayed. When it has been crushed and refined, if it yield anything of the pure gold of truth, or if it serve to attract others to the same mine who are better able to develop its wealth, the purpose of its publication will have been accomplished.

LEILA G. BEDELL.

CHICAGO, May, 1885.

THE ABDOMINAL BRAIN.

The expression which stands as the title of this little book is not, as many will suppose, altogether a fanciful one, but it has a definite meaning, which it is my purpose to attempt to interpret.

The term "*Abdominal brain*" was first used by Bichat, a French physiologist of great eminence, who was born in 1771 and who died prematurely in 1802, but not until he had impressed himself indelibly upon science in the new and important ideas which he developed in relation to the chemical, physical and vital properties of elementary tissues, and in being the first who recognized the importance of distinction between *animal* and *organic* functions, and to make this a basis of classification. In connection with this latter subject he gave birth to this expression—so full of significance, and so suggestive—the "*Abdominal brain.*" Corvisart, a scientific contemporary, in speaking of Bichat, has said, "*No one has done so much and so well in so short a time.*" Ruskin says: "The greatest thing a human soul ever does in this world is to see something, and tell what he saw in a plain way. Hundreds of people can talk for one that can think; but thousands of people can think for one who can see. *To see clearly is poetry, prophecy and religion all in one.*"

Bichet "saw something" nearly a hundred years ago, and told what he saw; but many of the Rip Van Winkles of physiology are still asleep, and the chord which he struck upon the harp of truth is all unheeded by them, though its harmony will echo down the ages of time, and somewhere at some time some one will discover its keynote.

The researches and reflections of this French physiologist led him to emphasize the *duality* of the human organism. He discriminated sharply between what he was pleased to call *Animal* and *Organic* functions; and he classified *all* organs and tissues and nerves as belonging to one or the other of these divisions. The Animal man was the outward, moving, thinking, seeing, feeling, hearing man. The Organic man was the collection of organs necessary to perform the functions of blood-making, blood purifying, and blood distributing, necessary to nourish and keep alive this other outer Animal man. All the Organic man was contained in the great cavities of the body—the thorax, abdomen and pelvis, surrounded by, protected by and provided for by the Animal man. The outer is the *bread-winning* man; the inner, the *bread-making* man. All the manifestations of *life* are by the outer man. The outer is the *instrument* of life; the inner, the *organ* of life. The impression which man makes upon the world is made by the brain and hands of the *Animal* organism. And yet this brain and hand would be powerless if the *Organic* man failed for one moment in the performance of his various functions. We might remove the fireplace from underneath the boiler of the engine, and seem to have a complete engine, with all its motor parts still perfect, but powerless for the want of the simple means of supplying the motive power—steam.

If we should undertake to separate the Animal and Organic man into constituent parts, as we would if we had a manikin before us, we would lay open the great cavities of the body and remove the contents. Beginning above, we would remove larynx and trachea, pharynx and œsophagus; lungs, heart, and great vessels leading directly from and to it, with the membranes surrounding these. This would empty the thorax; then from below the diaphragm we would remove the spleen, stomach, pancreas, liver, small and large intestines, the kidneys and pelvic organs, together with the membranes surrounding and connecting these organs. With all these, too, we shall unconsciously have removed a portion of an important system of nerves, including our abdominal brain. Laying all these aside, we should say to you, of such is *Organic* man. All that remains, all that surrounds the cavities containing these organs, is *Animal* man. Now the organs we have removed are all concerned in making blood to nourish and keep alive the outer organism. They represent the functions of respiration, circulation, digestion, absorption, secretion and excretion. And all these are presided over by a nervous system known as the "*Sympathetic.*"

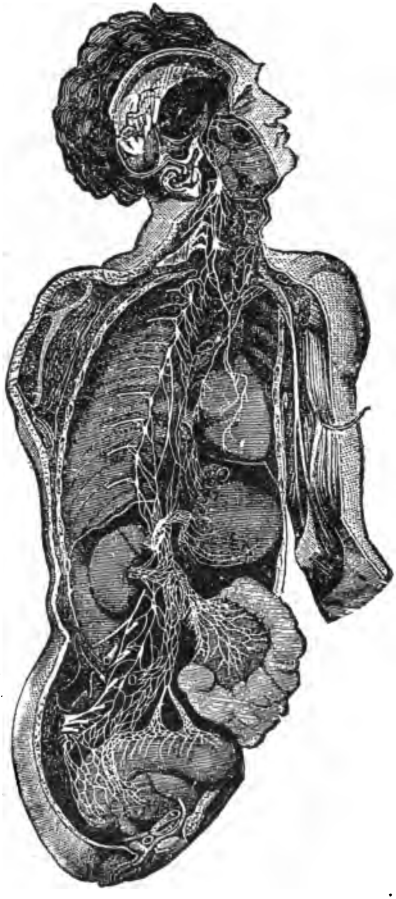
The *Animal* man, thus eviscerated, presents for our consideration the skeleton, muscles and integuments, and the organs of special sense. But within the skeleton we find still another cavity—not so easily reached as that from which we have taken all the organs concerned in perpetuating life; but we will get at its contents, grim and difficult as the process may seem to be. Removing the scalp, we will saw open a section of the skull and lay bare this kernel of the Animal organism, which is the brain, and which we find to be continuous with a homogeneous substance running down the long, narrow cavity of the vertebral canal—the spinal cord.

The brain and cord, then, with their cranial and spinal nerves, preside over the functions of *Animal* life. Here is the domain of *thought*, *reason*, *judgment*, *perception*, *will;* and here the seat of *voluntary motion.* Not a motion of a finger nor of an eyelid but this nervous system takes cognizance of it and furnishes the motive power. It is the force that beats down every barrier in the way of human progress. It is the mighty enginery that moves civilization in its onward march. It is power beyond comprehension! And yet this human will, this brain, with its exhaustless residual force, can neither add to nor take from the number of beats of the heart per minute; it cannot hasten or retard digestion; it cannot vary to the extent of one hair's breadth the motion of any organ of the abdominal cavity, any more than the engine can add a single tick to the daily movements of the watch! And why? Simply because the organic functions of man are under another and distinctly independent nervous system, subject to very different irritants—very different stimuli. And yet, even at the present day, many physiological writers ignore the distinctive features and properties of this nervous system of Organic life!

One of the latest, and in many respects one of the most complete and exhaustive, works upon the nervous system, "The Applied Anatomy of the Nervous System," by Prof. Ranney, of the University of New York—a work of 500 pages—dismisses the subject of this nervous system of Organic life—the Sympathetic system—with a consideration of *twenty-four lines in length!*

It will afford a curious study to any one who is interested, if he will take all the different authors in physiology, and compare what is said upon the subject of this nervous system. Flint's Physiology has the following: "While there are certain points in the physiology of the Sympathetic nervous system that are perfectly well established, it must be admitted that its functions are in many respects obscure, and that our knowledge of its general properties and its relations to the functions of nutrition, secretion, movements, etc., amounts to comparatively little. As far as we know, there is no account of the Sympathetic system even in the most recent works upon physiology, or in special treatises, a careful study of which does not convey the idea that there is little else in the literature of the subject than controversial questions of priority, etc., in minor details, and a few observations with regard to the effect of galvanization of Sympathetic filaments upon the functions of circulation and secretion, and upon animal heat."

Before this paper is finished, however, I hope I may have succeeded in showing which of the two nervous systems is of the greater importance to the actual well-being of mankind.



THE SYMPATHETIC SYSTEM, OR ABDOMINAL BRAIN.

It may be well for us, just here, to refresh our knowledge of their *anatomy*.

A nervous system is made up, primarily, of nerve cells and conducting fibres. A "nerve" is a bundle of these nerve fibres, just as a rope is a bundle of fibres of hemp. Every one of these fibres is an agency of conduction of nerve force, either to or from a nerve center or cell, centripetal or centrifugal fibres. Nerve cells are minute spherical bodies of microscopical dimensions, with usually two or more elongations of their substance which become continuous with the axes of nerve fibres, or form a center of a connecting fibre between this and another cell. Thus every fibre of every nerve of the body ends or begins somewhere in a nerve cell. That is, centripetal fibres end in or lead to a cell, while centrifugal fibres begin in or lead from a cell. Now, these cells are the seat of all reflex action in the nervous system. They correspond to the central office of the telephone system. By a centripetal wire leading from your residence you telephone the central office to connect you with your husband's office. A centrifugal wire *from* the central office gives you the circuit you desire, while the operator in the central office performs the *reflex action* or the function of the *cell* in giving you the connection. In a similar manner you touch your finger accidentally to something very hot. Immediately a sensory or centripetal nerve telegraphs the trouble to headquarters, and by reflex action in the cell a message is sent back by a motor or centrifugal fibre to a muscle: "Take your finger off the hot surface," and it does not take very long to get connection at the central office, either. Now, in the nervous system of Animal life, these central cells are collected into a grand aggregation and form the *gray* substance of the surface of the brain matter, and the center of the spinal cord, while the mass of white matter with which they are associated consists wholly of amassed conducting fibres. And it is probable that an individual cell performs but one act during life. And yet so lavish is nature with these life centers, that although she furnishes a separate cell for every motion, for every thought, reflection, memory, for every object seen during life, every sound, every taste, every odor, every sentence heard or read (and comprehended), every emotion, every consciousness of every name and nature,—still, when many of us shall have finished our threescore years and ten of active life and thought and study, we shall still have many empty, virgin cells; aye! an innumerable throng which no man can number. Memory might therefore be defined as the power of ransacking these stored-away cells to find the one which contains the record of a given act or thought. The gray matter in the child, in lower animals and in men of extremely limited brain action, bears a very small proportion to the amount of gray matter in the adult, thinking, active individual. It is believed by some that cells which have never been called into action possess none of the pigment which gives the peculiar tint to those cells which have performed their function, and which results from chemical changes in the blood supplied to the cell *at the moment of its activity.*

The Cerebro-spinal system—or nerve system of Animal life—comprises in its anatomical completeness the brain and cord as its great centers, and the twelve pairs of cranial nerves, named in the order of their origin from the front to the back of the brain— olfactory, optic, motoroculi, trochlearis, trifacial, abducens, facial, auditory, glosso-pharyngeal, pneumogastric, spinal accessory and hypo-glossal. These nerves supply all the organs of special sense, motion and sensation to face, tongue and lips, larynx and pharynx, besides furnishing the material for toothache and facial neuralgia.

The main portions of the body of Animal man are supplied by the thirty-one pairs of spinal nerves which are given off by two roots—an anterior and posterior—at regular intervals throughout the entire length of the spinal cord. These nerves—the cranial and spinal—with their innumerable branches, furnish the necessary nerve supply for all the physical and psychical functions of the outer man.

The Sympathetic, or nervous, system of organic life is not so easy of description.

Instead of having any great central mass of nerve cells like the brain, we find that its central cells are distributed in little clusters or ganglia (from the Greek *ganglion*—a knot) throughout its entire course from the head to the very lowest portion of the abdominal cavity; and its fibres or nerves form intricate network or plexuses (Plexus—from the Greek, to interlace, to entwine) of nerve fibres, extending to all the organs of the great cavities of the body.

There is, however, some order of arrangement to these clusters or ganglia of central cells, which are in fact so many little brains in relation to this system of nerves. We find, first, a double row of these ganglia lying just in front of the bodies of the vertebræ at the base of the abdominal and thoracic cavities. Another double row, or chain, may be found in connection with the posterior roots of the thirty-one pairs spinal nerves. Four more of these ganglia may be found in the head in connection with branches of the trifacial, one of the cranial nerves, and with which the fibres of the sympathetic are liberally mingled. Ganglia are also found upon the *roots* of the glosso-pharyngeal, the pneumogastric and the trifacial nerves.

Aside from these, in the principal plexuses of fibres of the sympathetic, numerous ganglia are found, and these plexuses (or networks of fibres) are numerous, there being one in connection with many of the principal organs of the cavities: the cardiac (heart) plexus, splenic plexus, hepatic (liver), renal (kidney), pelvic, mesenteric, diaphragmatic, etc. The most notable, however, of these plexuses is the *Solar plexus*, which seems to be the radiating and connecting center of the entire system, and the most notable and the largest of all its ganglia are the pair which form the center of this Solar plexus, called the Semilunar ganglia,—situated just behind the stomach, and forming the great center of reflex activity of the entire Sympathetic system. *To these large ganglia* it was that *Bichat* gave the name of "*the Abdominal Brain.*"

The parts of the body which receive nerve supply from this system of Organic life are all the blood-vessels which have fibres from the Sympathetic system, following wherever blood-vessels are found. The heart receives its power of contraction, or heart-beats, solely from the Sympathetic. The act of swallowing, the moment the food is passed by volition to the *entrance* of the pharynx, is an involuntary act through a power supplied by these nerves of the Sympathetic. The worm-like and wholly involuntary motion of stomach and intestines, which carries the food through the entire process of digestion, is the result of power derived from nerves from this same system. Respiration is chiefly performed by the same nerve-supply. All the secretory and excretory glands—liver, spleen, pancreas, salivary glands, kidneys, etc., etc., all perform their functions under the control of the Sympathetic. The uterus and ovaries, so richly endowed with nerve-supply, derive their *entire* functional power from the Sympathetic system. In short, every organ of the abdominal cavity—glands everywhere. And all these nerves and plexuses and ganglia are so intimately interwoven and connected, that a diseased condition in any part of the organic system will produce symptoms of the most varying character, and in organs extremely remote from the seat of the affection. And aside from supplying organic life with functional power, we find that by the intimate interchange of fibres between the Sympathetic and the Cerebro-spinal system, still other parts are brought into sympathy.

Every organ of special sense has a ganglion in connection with its special nerves, by means of which these also are intimately related to organic life.

We have already seen that the *will* is a powerful stimulant to nerves of the cerebro-spinal system, in which *all* motion is voluntary; that all the functions of the Animal man are largely under control of the *will*, while on the other hand it has absolutely *no power whatever over any of the functions of organic life.* But there *is* a psychical stimulus which has power to affect any or all the functions of organic life—and this stimulus is *emotion*.

The act of blushing, by which the capillaries suddenly expand their walls through the influence of some emotion, is an example of Sympathetic nerve activity under this stimulus. On the other hand, the sudden contraction of these vessels, which causes one to turn pale under the influence of fear, again illustrates the power of emotion over these nerves. The arrest of activity of salivary glands, producing *dryness of the mouth*, under the influence of intense anger, also vomiting from fright or anger, or diarrhœa from sudden or excessive grief, or other emotions, are examples of the same relation of emotion to this system of nerves and to disease.

On the other hand, diseases of any organ under nerve-supply from this system will produce a morbid emotional condition. Great depression and melancholia are results of uterine disease, dyspepsia or liver complaints. Indeed, the word melancholy *means* "*black bile*," as the words "hypo" and "hypochondriac" mean some trouble "*under the ribs*," from *hypo*, under, and *chondrium*, rib. One may have headache, toothache, earache, neuralgia, rheumatism, burns, bruises and cuts—in short, almost any ailment of the *animal* man, without the necessary accompaniment of serious mental depression, or morbid states of the emotions. The individual whose organic functions are regularly and perfectly performed is always in a corresponding state of mental exuberance. But the dyspeptic is continually on the negative side of the question—"Is life worth living?"—while the hypochondriac's solution of the conundrum would be, "That depends upon the *liver!*"

Disease, however slight, in any of the organs of the body which are supplied by this Sympathetic system, not only produces remote disturbances in other organs, but also *invariably produces altered and morbid states of the emotions* sufficient to seriously disturb our views and relations of life. Some of the most heartrending suicides have been committed under the direct influence of mental depression produced by diseased states of some of the functions of organic life. A diseased condition in remote organs through the intimate anatomical and physiological relations of these nerves, arising from hidden diseases of organs richly supplied with them, is almost an every-day experience in the life of the average physician, who experiences no little difficulty and embarrassment in explaining to the invariably incredulous patient that her trouble with the eyes, or throat difficulty, or fancied "heart disease," or cough, or headaches, may arise solely from some uterine disorder, and is purely a secondary and Sympathetic affection, which will disappear upon the removal of primary disease; and a still more difficult task is it to convince such persons that their moral views of life and their relations to their friends, are distorted solely by such diseased conditions, and that the world will seem brighter and friends more true when they are cured of these.

Again, we must note that long-continued disturbance of the emotions, as grief, anxiety, worry about business or health—*any* depressing influence long continued—will *produce organic disease*, by withdrawing from certain organs the nerve supply necessary for the proper performance of their functions, and *using it up in feeling*. Cases of dyspepsia from worry, or sadness, or anxiety about business, are of frequent occurrence. And these, too, are serious types of disease.

These facts presented in their various forms ought to be sufficient to show that *it is not the brain* which is the *seat of the emotions*, but the *Sympathetic system*. And if we should attempt to *locate* an emotion (a "heartache," as we say) anatomically, we would be pretty apt to place our hand directly over the *solar plexus* of the Sympathetic nerve system—or, in other words, over the *abdominal brain*.

The sharp distinction which has always been made in literature between the influence of the *head* and the *heart* upon mankind can find no reasonable explanation upon a scientific basis, except by referring man's moral nature to this nervous center of Organic life, and his intellectual nature to the brain, or center of Animal life. The oft-repeated expression "It was an error of the head and not of the heart" might reasonably be rendered, "It was an error of the cerebrum and not of the solar plexus (or abdominal brain)."

I have no more doubt of the correctness of this theory, that all emotion has its origin in this nervous center, than that the blood is oxygenated in the lungs. And if emotion has its seat in the "abdominal brain," then, too, that which is so closely allied to emotion, namely, *desire*, must also originate in this center. And activity in this center is antecedent to any activity in the nervous center of animal life. In the new-born child, the vaso-motor nerves of the chest and the cutaneous sensory nerves of the Sympathetic are the first to receive a stimulus—a *desire* for air; and *afterward* the center of Animal life responds to this stimulus in the reflex act of breathing, by a motion of chest muscles and the diaphragm. The next Animal impulse in the child is born of the *desire* for food, which surely originates with the Sympathetic. And so on for months the child exhibits evidence only of *desire* and *emotion*, in response to which alone arises all action of cerebral or spinal nerves. We teach the child to use its hands by placing before it some attractive object which excites desire to touch and handle; later to creep by first giving it the motive of desire. It takes its first step in response to the proffered metaphorical chromo—"Come to Mamma!"

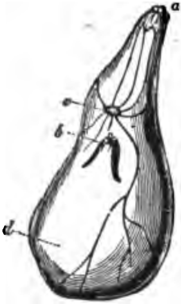
The emotions of love, hate, fear, anger, joy, pity, sorrow, are shown long in advance of cerebral activity as manifested in reason, judgment, memory, etc. It will be objected that the child early exhibits *will*, which is a cerebral function; but this is only in response to desire or emotion, and as purely reflex as the act of chest muscles in breathing. So the child is only an organic, emotional animal at first, and later on, by slow stages of development, becomes an intellectual being. Even its perceptions are automatic, and *will* has no power over the attention; being determined entirely by the attractiveness of an object, which is relinquished when a new object of attraction appears. Accordingly, we need not be surprised to find, in studying embryology, that this great centre of the Sympathetic—the solar plexus—has its development antecedent to and quite independent of the spinal cord. Beyond question the functions of nutrition and growth are the first to manifest themselves in the fructified ovum.

Having thus far attempted to show that the Sympathetic, or nervous system of Organic life physiologically and psychologically antedates the nervous system of Animal life—the brain and cord—let us now go back a good many stages, among the primitive forms of life, and see if this Sympathetic system may not also claim antecedence in race development as well as in the development of the individual.

Beginning at the very bottom of the scale of animal life, the simplest type of an animal consists of a minute mass of protoplasm—a mere microscopical speck of living jelly, having no mouth, no members, no organs; yet capable of motion by an inherent power of projecting a portion of its own substance into something like limbs (pseudopodia) and again withdrawing them into the common jelly mass. It also is capable of the function of nutrition by absorption and yet manifests capability of selection and rejection of nutritive substances.

It has no nervous apparatus proper,—none which is specialized, but only a *nerve force* which seems to be diffused through all the molecules of its protoplasm. Yet here even is distinct nervous action, and though nerve fibers are absent, we must still recognize the centripetal and centrifugal type of nervous activity. We can scarcely conceive of this mere speck of living matter possessing consciousness, or sensation, or intention, and yet naturalists tell us how from the same sandy bottom one species of protozoa picks up the coarser quartz grains, cements them together with phosphate of iron secreted from its own substance and thus constructs a flask-shape "test," or casing; while another picks up the finest grains and puts them together with the same cement into perfectly spherical casings of the most extraordinary finish, perforated by numerous small pores at pretty regular intervals; another builds his casings from minutest sand grains and the ends of sponge-spicules and works them up into white spheres; others make a many-chambered casing in similar manner. And yet Prof. Barnard (*Popular Science Monthly*, vol. 15, p. 764) has shown us that as *builders* these micro-organisms "have produced immense structures, *which far surpass in size all the colossal works of man.*" "Surprising as it may seem," says this writer, "it is true that, substantially, these rhizopods built the temples and mammoth pyramids of Egypt, and the stone walls of Vienna and Paris, for the very rocks of these structures, as well as those which surround the Mediterranean Sea and extend thence to the Himalayan mountains, are chiefly built up by their infinitely numerous shells," and the barren rocks, twenty feet thick, on which Richmond, Va., stands, consist mainly of their discoid shells.

Passing the *Radiata*, among which are the coral-builders, and which are only a step advanced from the Protozoa toward members or any nervous centers, we come to the Mollusks—invertebrates having soft bodies, no articulations, but a low form of organic structure and a form of nervous system. These include the oyster and other bivalves, the snail and similar univalves, the nautilus, etc.



" THE ASCIDIAN MOLLUSK."

In the lowest of this division—the Ascidian Mollusk—the animal consists merely of a membraneous sac, with a mouth orifice, and a semblance to an alimentary canal. Within the cavity of this animal we have a single nerve ganglion, which sends fibres to the mouth, the alimentary tract, and to the membraneous sac or skin covering. Here undoubtedly is the parent form of our Sympathetic system, and *in this solitary ganglion* we have beyond question the original form of the *Abdominal Brain.*

"In ascending through this Mollusk series," says Carpenter, "we find the nervous system increasing in complexity in accordance with the increasing complexity of the general organization." As organs of special sense or sensation are added ganglia are increased. In the Cephalous Mollusks we find a pair of ganglia in the head connected with the organ of vision. These may be either the rudimentary form of the head ganglia of the Sympathetic as found in man, or the rudiment of the Cerebro-spinal system. These head ganglia are connected by cords which pass around the œsophagus and become connected with other ganglia situated in the cavity of the body—the Sympathetic ganglia of the Mollusks.

In the nautilus, which is among the most complex of this series, we even find fibres running out through the eight arms, and also supplying the peculiar web membrane which it uses as a sail. These fibres are capable of reflex action and show a centripetal and centrifugal influence upon these members. This hints of even a primitive form of motor and sensory nerves. The shell of this animal is chambered, and each season as it grows, needing a larger house, it builds on a new front room of larger dimensions, and abandoning its old apartment moves in. This fact, while contemplating a broken nautilus shell, gave Oliver Wendell Holmes the inspiration for a little poem, of which it is related that when he had finished it he rushed into his wife's presence, exclaiming, " Oh, Mary, I have written something *better than I can write!*" And he read her his

CHAMBERED NAUTILUS.

"This is the ship of pearl which, poets feign,
Sails the unshadowed main,—
The venturous bark that flings
On the sweet summer wind its purple wings
In gulfs enchanted, where the Siren sings,
And coral reefs lie bare,
Where the cold Sea-maids rise to sun
Their streaming hair.

"Its webs of living gauze no more unfurl;
Wrecked is the ship of pearl!
And every chambered cell
Where its dim dreaming life were wont to dwell,
As the frail tenant shaped his growing shell,
Before thee lies revealed,
Its irised ceiling rent, its sunless crypt unsealed!

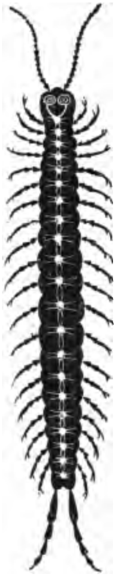
"Year after year beheld the silent toil
That spread his lustrous coil;
Still as the spiral grew,
He left the past year's dwelling for the new,
Stole with soft step its shining archway through,
Built up its idle door,
Stretched in his last-found home, and knew
The old no more!

"Thanks for the heavenly message brought by thee,
Child of the wandering sea,
Cast from her lap, forlorn!
From thy dead lips a clearer note is born
Than ever Triton blew from wreathed horn!
While on mine ear it rings,
Through the deep caves of thought I hear
A voice that sings:—

"Build *thee* more stately mansions, O my Soul,
As the swift seasons roll!
Leave thy low-vaulted past!
Let each new temple, nobler than the last,
Shut thee from heaven with a dome more vast,
Till thou at length art free,
Leaving thine out-grown shell by Life's
Unresting sea!"

This poetical digression must find its excuse in the beauty of such a tribute to a representative of the Mollusks, which stand to us as the Adam and Eve of our "Abdominal Brain."

Another step in the scale of animal life gives us the *Articulata*, which include the insects and the worms. Here we find still a gradual increase in the complexity of the nervous system in accordance with the increase of differentiation of organs. The *Centipede* is a fair representation of this subdivision. Here again we have two cephalic ganglia, and, on a lower plane, a connected chain of abdominal ganglia, bearing a striking resemblance to the prevertebral chain of the Sympathetic ganglia in man.


"The Centipede."

But thus far, while we have demonstrated a well-defined Sympathetic system, we have not as yet reached any very clearly defined rudiment of the brain and cord. For convenience, zoologists call the pair of superœsophageal ganglia the "brain" of insect, but its claim to any characteristics of a brain is questionable. The plan of the nervous system in all the lower forms of life, in fact in all invertebrates, is fundamentally the same. The first chain of ganglia we find is ventral, lying upon the floor of the body cavity. The nervous cord of one of the Ascidians is a similar chain of ganglia occupying a dorsal position. This might be regarded as anticipating what we find in the lower vertebrates, notably in the lancelet, which will be described hereafter. Before leaving the invertebrates, however, I wish to call attention to one significant fact which foreshadows that dual character of higher animals toward which we are reaching, namely, that after the "jelly specks"—as soon as we come to skin-covered animals—we find this skin consisting of two layers, the outer or motor layer, and the inner or intestinal layer. It is to be inferred that the functions of the animal system of nerves thus far are performed by this motor skin-layer through diffused nerve force—molecular nervous matter. Indeed in those low forms where nervous energy seems to be merely diffused through protoplasmic cells we find some analogy to the action of nerve force in the more differentiated nervous systems of higher animals.

Lastly in the scale of animal life we have the Vertebrates, at the top of which series is man, and at the bottom, as a connecting link between vertebrate and invertebrate, we have the *Amphioxus Lanceolatus*, the most primitive form of all vertebrate animals. It has no specialized head, no brain, no skull, no jaws, no limbs. But its importance in relation to the study of higher forms is immense. It is on the border land between the two great divisions, the invertebrates and the vertebrates; and is the only living skulless vertebrate yet discovered. It is found on the Scandinavian shores of the North sea and on the Mediterranean. It belongs undoubtedly to the fish family. And while it has no vertebral column proper, it has a delicate cartilaginous rudiment of one. This is enclosed in a sheath, and in this sheath also is discovered a tube, and in this tube is found a central nervous system—a rudimentary spinal cord. At the upper end of this, the sheath forms a small, hardly noticeable bladder-like swelling of the canal, and this is at least the *prophecy of a brain* as we go higher in the scale of life.

Farther than this we need not trace these rudimentary forms.

Sufficient has been done to show that the *Sympathetic* system antedates the Cerebrospinal in the development of the race as well as the individual. This organic system of nerves is pre-eminently at the root of all life; the first to manifest itself in the insect and the infant, and the last to cease its functions when death has set his seal upon a living organism. We have said already in speaking of the brain and cord system: "It is the mighty enginery that moves civilization in its onward march." Let us revise: *the fire beneath our engine is the abdominal brain.* The grandest deeds of heroism, or patriotism, have had their origin in the promptings of an *emotion.* Grand *desires* give birth to grand acts.

And yet these two systems are as inseparably connected as the two organisms over which they preside. They may well be compared to a two-celled battery. Their action, like that of electricity, and like that of the blood, is in a circle.

The action of the Sympathetic is always toward the center; that of the brain and cord always toward the periphery. The physiologist will here desire to remind me that the Cerebro-spinal system has both centrifugal and centripetal nerve fibers; both motor and sensory. Yes, that is accepted physiology. But I beg to ask such critic to point me out a single cranial or spinal nerve, having sensory or centripetal fibers, which has not upon its root, at its very origin, a *ganglion of the Sympathetic system.*

But what concerns us most about this battery—the dual nervous system—is how to maintain it in a state of vigorous activity; how to maintain it in what physiologists would call a well-balanced electro-tonic state. This can only be done by a proper equipoise between the states of activity of animal life and organic life; by proper alternations of rest and exercise; and by an intelligent recognition of the disorganizing power of extreme psychical states, especially that of emotional activity.

We have already seen that our abdominal brain presides over a system of nerves supplied to *all the organs of life*—organs which, unlike the organs of the animal body, never sleep, never cease their functions. You will at once recognize the importance of the vigor of this particular system in the maintenance of health, since, practically, all variations from a standard of health—all disease has its origin in faulty function of the organic system. I maintain that the outer or Animal organism has nothing whatever to do with states of disease or health, except perhaps in a mechanical way, as the machine through which and by which we are brought into relation with the outer world for purposes of supplying our daily bread and other physical necessities.

If the outer or Animal man is diseased it is wholly through mal-administration of the functions of the Organic man. No matter whether it is hip-joint disease, carbuncle, neuralgia, rheumatism, skin-disease—all are to be set down to the account of mal-assimilation, imperfect or vitiated nutrition.

Now a nervous system having so much responsibility already resting upon it should not have the addition of any unnecessary or avoidable taxation in the way of functional activity, either physical or psychical. Therefore we should think, feel, eat, sleep and exercise like rational beings. But you will say sleep and exercise are for the refreshing of the animal man, to restore the animal functions. Very true; but suppose you keep your animal man in perpetual activity, whence the source of supply of nutrition to provide for such activity, and the absorption to carry off the waste? This organic system is like many another good wife who works while the man sleeps to get something ahead in preparation of food for his nutrition. If he sat up all night and ate as fast as she could cook, I fancy she would soon give out, just as our Organic system does when we tax it in a similar manner.

If you accept also the proposition that this abdominal brain is the seat of emotion, you will see at once what a "thief in the night" *depressing emotions* must be upon the storehouse of the good wife in this state of physiological wedlock between these two life centers, who tries to keep up the supply of nutrition.

Imagine, if you please, a colony upon the dry plains of Colorado, where the settlers have decided upon the experiment of artificial water supply; for we assume that, here, at least, water seems the one thing needful to life and activity. For convenience we will locate the mechanics, tradespeople and professional people near one end of this tract, and the food producers—the farmers—at the other. For water supply two great reservoirs have been supplied at either end of this tract to accommodate the two settlements. The one to irrigate the land for farming purposes and supply the daily necessities of life; the other to furnish water for machinery, and also to supply the wants of the households and individuals. These two great reservoirs it is agreed shall be connected by a channel leading from one to the other, so that in case of any emergency, such as fire or drouth, if the supply of one be exhausted, they can draw on the other; or, in case of a great drouth they could stop machinery and stop work, but they could not very well get along without the supply of food which depends upon the proper water supply to the farmers of the colony. Whatever else stops this supply must be furnished. At last it is agreed that an extra pipe may be added to each reservoir, not for necessity, but pleasure. The village wants a fountain and skating-rink, and their rural friends want a fish-pond. Finally, they discover that they must have some system about this water supply. If they draw off too much for the skating-rink and the fountain, they find that their mechanical industries suffer. Or if, at this reservoir, the inhabitants insist upon using all they wish for both purposes, they overdraw through the connecting pipe on the other reservoir and the food supply fails. On the other hand, at the other reservoir the people found that by running too much to fish-ponds they had drawn to excess for pleasure upon their supply of water and thereby ruined their crops, and were also draining off the supply which belonged to the village people, thus seriously interfering with *their* legitimate activities. At length they found that all these troubles arising from an overdrawn water account must be remedied, and could be remedied in one word,—*moderation;* a reasonable exercise of all the privileges.

So we find in the double reservoirs of the nervous supply in man, which is not only a dual system but each system is dual in function; the one supplying force for voluntary motion and the intellectual activities; and the other for involuntary motion of all the organs of nutrition, and for emotion and sensation. If the brain is used to excess and to the exclusion of muscular exercise the muscles suffer. If the muscles are used in excess and to the neglect of the brain, the intellect must suffer. But the greatest of all evils is the excess of emotional activity, for by this means nerve supply is withdrawn from *all* the functions of *organic* life and organs thus become diseased and the whole system suffers in consequence, because the *whole* system derives its entire nutrition from the organic portion. We hear a great deal about excessive brain-work, brain-fag, etc., but the crying evil of psychical excess is not from an over-worked brain, but from an over-worked *abdominal brain through excessive emotional activity.*

No child's *brain* is over-taxed in schools. A vigorous exercise of intellectual activity gives zest to the enjoyment of recreation in physical exercise, and both these add stimulus to nutritive functions. Appetite is good, digestion is good, and sleep is refreshing. But (and I ask you to mark well the other side of this question) the sensitive child, with large approbativeness, working hard to stand well in classes and now and then failing of the desired standard, and losing "credits," suffers *chagrin* and *disap-*

pointment, or perhaps pungent sorrow and mortification, the very memory of which so distracts the mind in subsequent efforts, that failures rapidly multiply. *That* child grows nervous and irritable, and school work wears upon her so that a change becomes necessary. She loses her appetite; hurries away to school with almost no breakfast because she feels that her success in classes demands every moment of her time, or she is so solicitous that she cannot eat. Her pain at falling short of her aim spoils her appetite for lunch and at dinner she is not hungry.

Oh! ambitious mother, who delights to say, "My little girl stands at the head of her class," *have you counted the cost?* Do you know that this strain of continued effort to *excel others* measures itself in years from the length of that child's life? Let the ambition to *do well* suffice, even though the child stand on a common plane with many others. Save her from that precipice of exalted ambition to excel everybody else, where one misstep will plunge her into the blackness of blighted hopes,—for it means nervous shock—shock to the *abdominal brain*, and evil to the functions of life.

Teach children rather to do their best in studies, as in everything else, for the sake of the excellence of the thing itself, and shield them from everything which excites unlawful ambition or leaves them liable to chagrin from failure after proper and laudable efforts. Applaud rather the dull children who do hard work with poor returns, because they have done their best, which is all any of us can do.

And so it is with business men. Fourteen hours a day of hard brain-work need leave no scars upon the health, provided that work is attended with much success and no anxiety. Fourteen hours a day of business anxiety, with failure staring one in the face, will tell upon the health of any one in a single week! In the first instance, the balance of the system is not disturbed; in the second, excessive emotional activity in form of worry takes all the nerve supply from nutritive functions, and if long continued a confirmed dyspeptic is the result.

The question has been asked why men are more the subjects of dyspepsia than women. Because in women these reflex phenomena resulting in disturbed functions show themselves more frequently in pelvic organs, while in man the stomach or liver are the organs most affected by the loss of balance in this nerve supply.

Hysteria is pre-eminently a disease of the Sympathetic system. Women are vastly more subject to it than men; the latter, however, are by no means entirely exempt. In women it is usually the result of irritation in remote organs supplied almost exclusively from the sympathetic—the uterus or ovaries. But it may arise entirely from a diseased condition in the solar plexus itself, resulting from long-continued and too intense emotional states, and notably those which may be classed as erotic.

Surgical operations upon the uterus which leave cicatrices are followed by long-continued "nervousness" because of the irritation which these scars cause by pressure upon fibres of this nervous system.

In relation to health it is not after all so great a question in regard to *what* we shall eat and how it shall be prepared in order to keep this bloodmaking organic organism, and through it the animal organism, in the best possible condition, as it is under what *conditions* we shall eat and how shall we keep this "abdominal brain" which presides over all these plexuses of nerves of organic life in the highest possible state of healthful and vigorous activity. For by this means we preserve the highest state of functional activity. How shall this be done?

I answer, by preserving the equilibrium of *both* our "reservoirs." By maintaining a proper physiological balance of *all* functions; not overdrawing upon the intellectual or the emotional; upon the physical or functional. Use all your organs without abusing part. Cultivate brain and muscles of the animal *man;* and exercise the emotions in a healthful way and all the other functions of the organic *woman.*

"He that hateth his brother is a murderer" has a physiologically literal meaning. He who wounds the feelings or in any way embitters the life of another person, inflicts a wound upon this great physiological life-center—the abdominal brain—and disturbs the functions of life; in a certain sense destroys life. Unkind words are more cruel than the bistoury or scalpel. These only wound the flesh which kindly heals and gives no sign that it remembers. But heart-hurts are slow to heal, and their scars always remain an irritant to the centers of life!

Our emotional nature was given us for happiness—not pain, and when we suffer this kind of pain it is as much in opposition to the Divine intention concerning us as when we put our hand in the fire.

In conclusion, the well-being of this Abdominal Brain, or rather of the entire Sympathetic system of nerves and nerve-cells, especially concerns women. And simply because anatomically they possess a more extensive distribution of its fibers than man; and because physiologically this system in woman is subjected to far greater activity both physically and psychically. Hence we find that women are more emotional than men, more sympathetic, more loving, more tender; except—(and the exception proves the rule)—under morbid states of this center, and then we find that woman can be exceptionally more pitiless, more censorious, less merciful, even to her own sex, than man. Surely a woman is never so unsexed, so "man-ish," as when she is pitiless toward any human being.

And, lastly, I believe that this center especially concerns woman (and this is the very acme of physiological heresy, but I utter it not as mere speculation, but as an honest conviction of a new scientific truth born of years of thought and study upon the origin of sex*)—*because woman is its author; because it is her contribution to the embryo of every human being*, man or woman, and that it pre-exists in the virgin ovum *as its life principle;* and that in the physiological wedlock of the two cells which form the embryo, it pursues always the same

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*Within the past ten years the writer has spent much time upon microscopical work, and upon study and preparation of papers looking toward a scientific solution of the problem of sex. Her thesis upon the occasion of graduation from Boston University School of Medicine was upon "The Origin of the Two Nervous Systems, the Basis of Sex and of Man's Dual Psychical Nature." In studying the subject from the standpoint of the doctrines of Evolution (which in the main she accepts) she has prepared papers upon "Sex in Cell," and upon "Bi-cellular Evolution" and the "True Nature of Sex." In these the doctrine of *coalescence* is repudiated in favor of an independent physiological development of the primary cells which *unite* but do not "coalesce." Upon the occasion of one of these papers being offered to the *Popular Science Monthly*, in the hope of subjecting its theories to the test of severe scientific criticism, Prof. Yeomans in declining to publish the paper because it "takes radical issue with existing scientific views," after saying "I am not a judge of the subject you discuss" and "our main constituency is not competent to judge of the obscure biological questions raised by you" he paradoxically adds "*It is too clean and complete and positive a solution of the most profound and perplexed of all biological problems to be probably true*" (*!*)

order of development, resulting always in the Organic, just as the spermatozoid produces the Animal organism with its brain and cord!

And I believe that physiological writers of the coming centuries will teach us that Sex, in its deeper meaning, is only an expression of convenience representing a factor of a *dual force in Life*, just as electricity is a dual force among elements, expressed by the terms positive and negative; just as in Nature that dual force through which all bodies of the universe are kept from jostling each other in their orderly movements is expressed by the terms centrifugal and centripetal; and that in what is recognized as Vital Force, woman is the negative, man the positive; woman the centripetal attractive force which holds centrifugal man steady in his orbit and preserves the integrity of the social circle. And from this standpoint, when Science reaches the limit beyond which it cannot pass, Philosophy will say that in the end the great Source and Author of this dual Life will gather up the individual fragments of this dual Force just as the magnet gathers to itself the iron filings, because it claims its own by virtue of a law of attraction which will suffer nothing akin to it to be lost; by virtue of a common law which turns the positive forever toward the negative, the needle toward the pole, the planets toward their sun!

If the positive and negative properties of zinc and carbon or other similar elements had remained unknown to man, Nature would still have her batteries at work and by the thunderbolt announce the existence of this great force; or if these elements were to become extinct there would still be electricity in nature; still the eternal going out of the Positive toward the Negative. So let us believe that when "the silver cord is loosed," and the connection severed between these two great nerve centres of the living battery of Animal and Organic Man, that still that which IS Life will survive the broken instrument and pass on to new methods of manifestation in a new environment.

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